3.4

Properties of Logarithmic Functions

Product Rule: $\log_a(MN) = \log_a M + \log_a N$

Quotient Rule: $\log_a\left(\frac{M}{N}\right) = \log_a M - \log_a N$

Power Rule: $\log_a(M^r) = r\log_a M$

Note: If M = N then $\log_a M = \log_a N$

If $\log_a M = \log_a N$ then M = N

See example 1 pg. 310.

Expanding the logarithm of a product:

Example 2 pg. 311.

Expanding the logarithm of a quotient:

Example 3 pg. 311.

Condensing a logarithmic expression:

Example 4 pg. 312.

<u>Change of base formula</u>: if $a \neq 1$; $b \neq 1$ and a, b, and M are positive real numbers

$$\log_a M = \frac{\log_b M}{\log_b a} \qquad \log_a M = \frac{\log M}{\log a}$$

$$\log_a M = \frac{\ln M}{\ln a}$$

Evaluating logarithms by Changing the Base:

Example 5 pg. 313.

Logarithmic functions with b>1, $f(x) = \log_b x$

Domain $(0,\infty)$

Range: All reals

x-intercept = 1

y-intercepts: none

continuous

Increasing on its domain

No symmetry: neither even nor odd

Not bounded above or below

No local extrema

No horizontal asymptotes

Vertical asymptote: x = 0

End behavior: $\lim_{x\to\infty} \log_b x = \infty$

Passes through (1,0) and (b,1)

One-to-one

Concave down